USING NAVY RANGES FOR BASIC RESEARCH IN UNDERWATER ACOUSTICS

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LONG-TERM GOAL

The long term goal of this project is to contribute to the understanding of underwater acoustics in a cost-effective fashion by using the extensive in-water acoustic hardware provided by navy ranges. An additional goal is to use the existing and planned range hardware and ocean acoustic imaging and communication techniques to better understand oceanographic phenomena such as internal waves.

SCIENTIFIC OBJECTIVES

The short term objectives was to determine the feasibility of using existing and planned range hardware to achieve the long term goals. We needed to establish the ease in which measurement systems could be connected to the existing range hardware. We also wished to define in a preliminary fashion what experiments could be performed and the usefulness of the scientific information they would provide.

APPROACH

Our current approached is to focus on the Pacific Missile Range Facility (PMRF), Kauai, Hawaii. Of all the Navy ranges, PMRF has by far the most extensive suite of in-water hardware. The existing range area covers 1000 sq. miles with water depths from 600 m to over 2200 m, with 60 receivers and 5 transmitters. A shallow water training range is planned for installation in fiscal year 1998 with an additional 16 sources and 178 receivers in waters from 40 m to 600 m. The frequency range of the existing sources is from 8-12 kHz. The planned shallow water range will have two sources that will operate from 1-3 kHz, while the others work in the range of 8-12 kHz. The receivers have a wide

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bandwidth from 50 Hz to 20 kHz. Our approach is to determine the oceanography of the region covered by the PMRF range and determine the usefulness of performing acoustic studies using the existing and planned hardware.

WORK COMPLETED

We determined the extent and capabilities of the existing and planned PMRF underwater acoustic hardware. We also investigated the environmental conditions, including the sound speed profiles, bottom properties, and presence of internal waves and internal tides. To determine the usefulness and feasibility of performing acoustic studies, we modeled the acoustic propagation. This included modeling the inversion to determine the three-dimensional sound speed profile using simulated data taken with the existing hardware. A small data set was acquired in which a 10 ms long, 9 kHz sine bursts was transmitted out of one of the sources and recorded on several of the bottom mounted hydrophones. A report on our results was written and delivered to ONR.

RESULTS

We determined that indeed it is possible to perform acoustic experiments by interfacing with the PMRF in-water hardware. The are significant and important acoustic and oceanographic phenomena which could be studied at relatively little additional expense using this extensive suite of sources and receivers. Of special interest is the possibility of using acoustic tomography to performing long term monitoring of internal waves and deep internal tides which form around the island. The data acquired demonstrated the ability to collect signals which could be used for inversion. The modeling of the tomographic inversion using the simulated data showed that we were able to image the deep internal tides.

IMPACT/APPLICATION

The impact of the work conducted so far is that there may be an inexpensive way of conducting long-term acoustic studies by making dual-use of existing range hardware. It is also very important to Navy fleet operations to understand the deep internal tides which form around islands.

TRANSITIONS

The next step will be to conduct a more extensive study. This includes further modeling and an experiment to perform acoustic propagation studies along with the acoustic inversion.

RELATED PROJECTS

This project is related to many of the underwater acoustic studies of high frequency (greater than 5 kHz) propagation. It is also related to ocean acoustic tomography and efforts underway to study internal waves and internal tides.